



#### **Outline**



- → Definitions
- → Policy
- → PEO TSC Instruction
- → PEO TSC Best Practices Guide
- → VV&A Implementation
- → Summary

28 September 2000



#### **VV&A Definitions**



- "Verification the process of determining that a model or simulation implementation accurately represents the developer's conceptual description and specification"
- "Validation the process of determining the degree to which a model or simulation is an accurate representation of the real world from the perspective of the intended uses of the model or simulation"
- "Accreditation Accreditation is the official determination that a model & simulation, hardware-in-the-loop, or land based test site is acceptable for use for a specific purpose"

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#### M&S VV&A



"Did I build the thing right?"



**Developer** 

**VERIFICATION** 

"Did I build the right thing?"



**Subject Matter Expert/Developer** 

**VALIDATION** 

"It suits my needs"



Requester/User

**ACCREDITATION** 

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#### **Definitions**



- Accreditation Authority (AA) An Individual Occupying a Position With the Appropriate Rank, Grade, Responsibility And/or Authority to Accredit a Model, Simulation, or Federation of Models And/or Simulations for a Particular Purpose or Purposes. For Design, Development, and Developmental Testing, This Authority Resides With the Program Managers. For Operational Testing, This Authority Resides With the Commander, Operational Test and Evaluation Force.
- Accreditation Review Panel (ARP) The Program Office Organization Responsible for Managing the Gathering and Review of V&V Information and Presenting an Accreditation Recommendation to the Program Office on All Program Controlled M&S. It Is Composed of Program Office Representatives and Subject Matter Experts As Appropriate. The ARP Establishes the SCP.

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# Definitions (continued)



- Simulation Control Panel (SCP) A Technical Review Panel Established by the ARP to Guide the Gathering of V&V Information. It Provides the Independent Oversight of the Execution of the V&V Plan and Reviews the V&V Efforts of the MSP.
- Modeling & Simulation Proponent (MSP) A Developer, Maintainer, Modifier, User, or Sponsor of M&S Applied to Navy Programs. The MSP Provides the Required V&V Information, Conducts V&V Activities, and Supports the ARP and SCP As Tasked.

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#### Philosophy



- → Don't re-invent the accreditation "wheel"
- Practical, acquisition-oriented accreditation process
- - DOD Directive 5000.59, "DOD M&S Management," 4 January 1994
  - DOD Instruction 5000.61, "DOD M&S VV&A," 29 April 1996
  - SECNAV Instruction 5200.40, "VV&A of M&S," 19 April 1999
  - PEO TSC Instruction 5200.3, "VV&A of M&S," 4 February 2000
  - COMOPTEVFOR Instruction 5000.1, "Use of M&S in Operational Testing," 5 September 1995
  - DMSO "VV&A Recommended Practices Guide," November 1996





# PEO TSC Instruction 5200.3 "VV&S of M&S," 4 February 2000

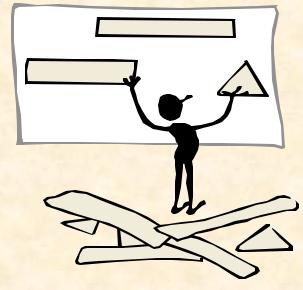




#### **Purpose**



→ To establish Verification, Validation and Accreditation policy and provide a consistent framework for VV&A of M&S used to support program acquisition



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#### **Contents**



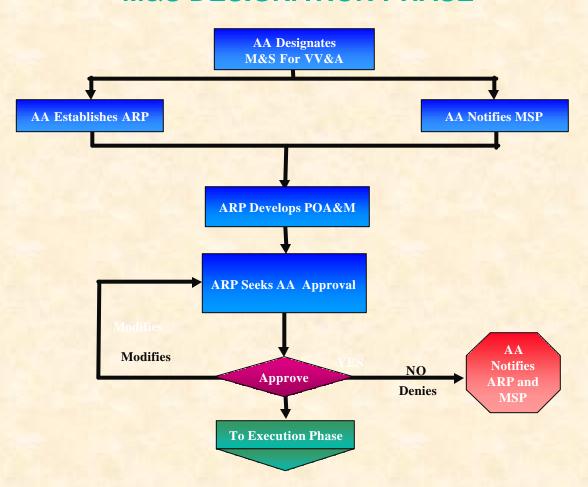
- → Purpose
- → Applicability and Scope
- → Background
- → Policy
- Responsibilities
- Definitions and Acronyms
- → Review Responsibility



#### **Standard VV&A Framework**



#### **M&S DESIGNATION PHASE**

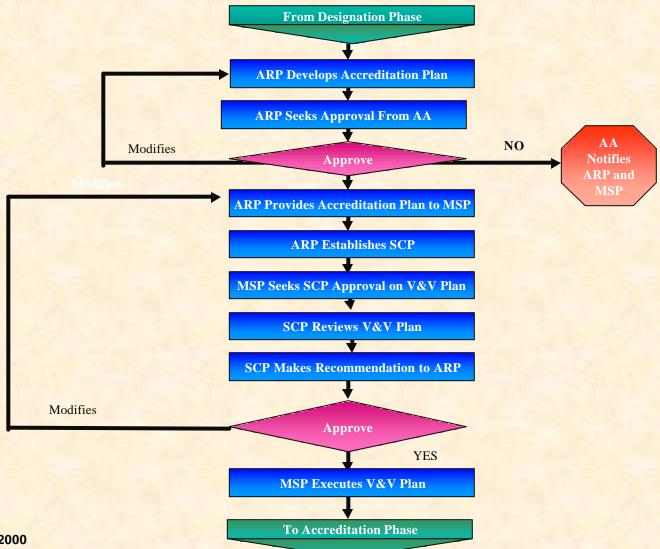




#### **Standard VV&A Framework**



#### **V&V EXECUTION PHASE**

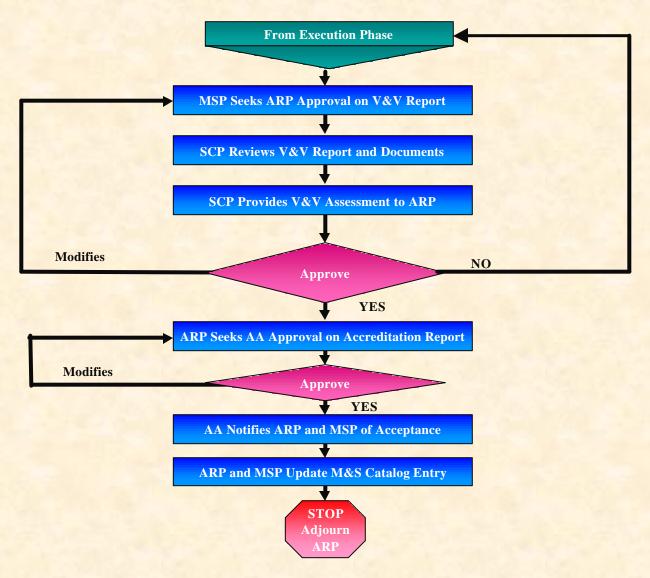




#### Standard VV&A Framework



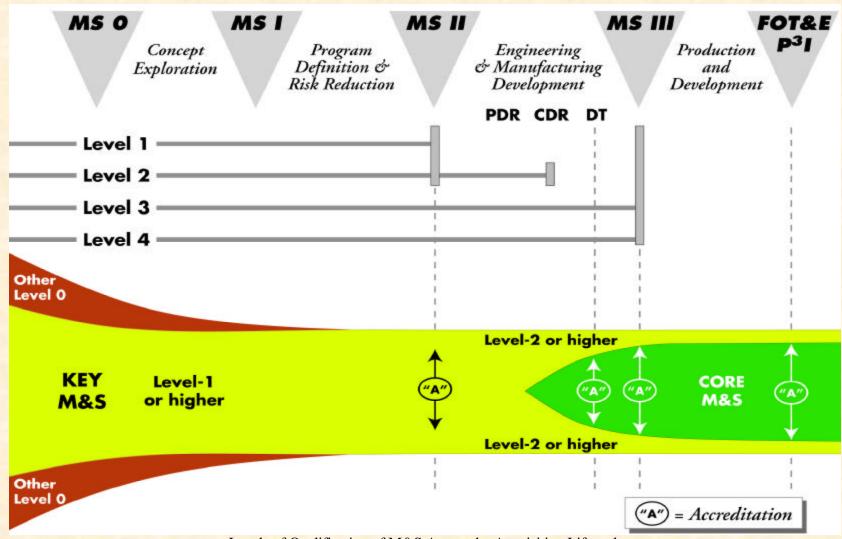
#### **M&S ACCREDITATION PHASE**





#### **M&S Qualification Categories**













### **Purpose**



Provide Program Managers with guidelines on how to perform Verification, Validation and Accreditation in support of their acquisition programs





#### **Contents**

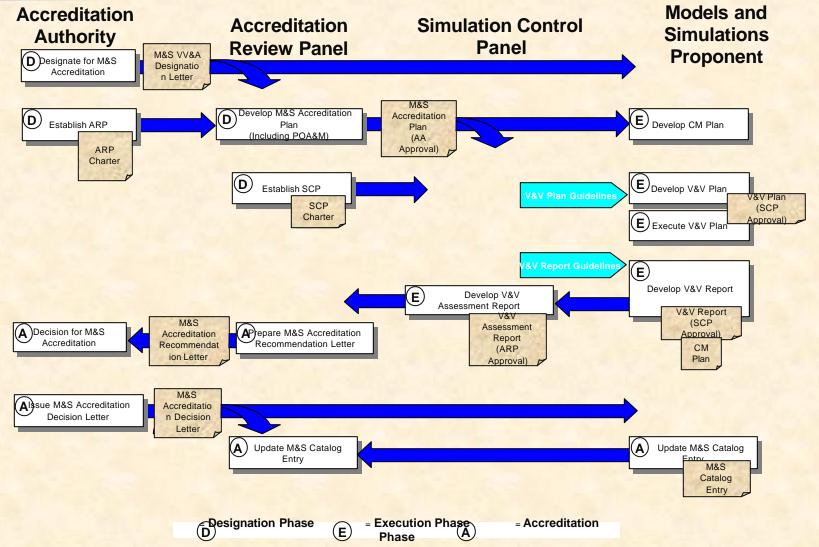


- Executive Summary
- → Purpose
- → Scope
- General Accreditation Approach
- Accreditation Guidelines
- New Models or Simulations
- → Hardware-in-the-Loop
- Validation of System Representations
- Data Accreditation



#### **General VV&A Process**







#### **Participants**



Accreditation Authority (AA)

Accreditation
Review Panel (ARP)

Simulation Control Panel (SCP)

Models and Simulations Proponent (MSP)

Senior
management
or command
level directly
responsible to
approve the
use of an
M&S for a
particular
application(s)

AA
representatives
and subject
matter experts
as needed

Technical subject matter experts from the Program Office and supporting organizations

A developer maintainer, modifier, or user of an M&S designated for VV&A

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#### **Products**

Charter



# Accreditation Authority M&S VV&A Designation Letter ARP Charter SCP

#### Simulation Control Panel

M&S
Accreditation
Plan
(AA
Approval)

Models and Simulations Proponent

V&V Plan (SCP Approval)

M&S
Accreditation
Recommendatio
n Letter

M&S Accreditation Decision Letter V&V
Assessment
Report
(ARP
Approval)

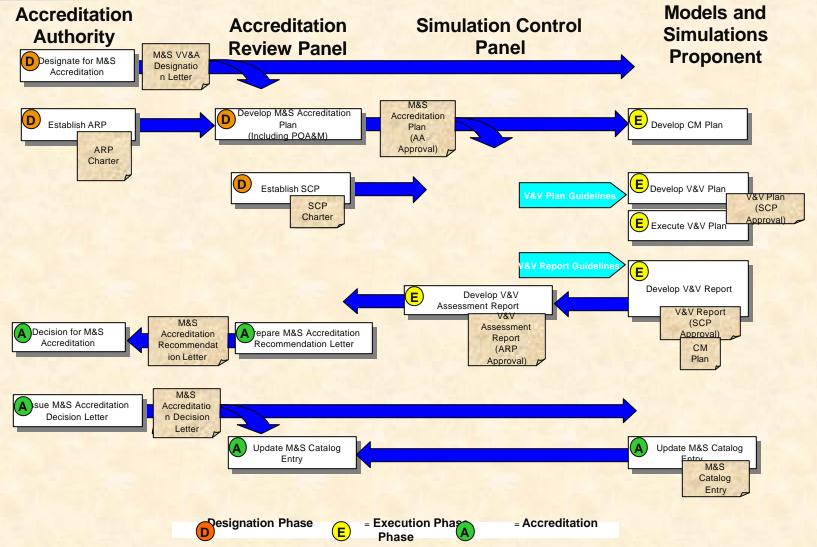
V&V Report (SCP Approval) CM Plan

> M&S Catalog Entry



#### **M&S VV&A Process**







## **Legacy M&S**



#### **Designation Process**

- Identify Need
- Identify Sponsor
- Establish M&S Requirements
- Understand M&S Functionality
- → Develop POA&M
- Make Designation Decision





#### New M&S



- Designation Phase is coupled with the Development Process
  - Define M&S Requirements
  - Plan M&S Development
  - Develop Conceptual Model
  - Develop Design



#### Hardware-in-the-Loop



- □ Integration of simulations, stimulators, hardware, and operational components
- VV&A Approach
  - M&S Requirements
  - Major Functionalities
  - Diagram of fielded operational system
  - Diagram of the HWIL system differentiating among M&S, non-tactical, hardware, and operational components
  - Description
  - V&V on each component



#### **Data Accreditation**



- □ Currently PEO TSC does not have a process in place
- → Our data is currently reviewed by Subject Matter Experts (SMEs)
- → Have letters that explain the pedigree of the data



# Validation of System Representations



#### **Process Overview**

Any M&S Data Request Received by PEO TSC Divisions Is Forwarded to TD1MS

Response and Release Coordination by TSC-TD1MS

Initial Response and Recommendation for Action to TD In Conjunction With the M&S Strategy Council (MSSC)

TD or TA Assigns TD1MS or PM Lead for Response

**Data Production** 

Certification and Release by TD or Lead PM



# Validation of System Representations (Continued)

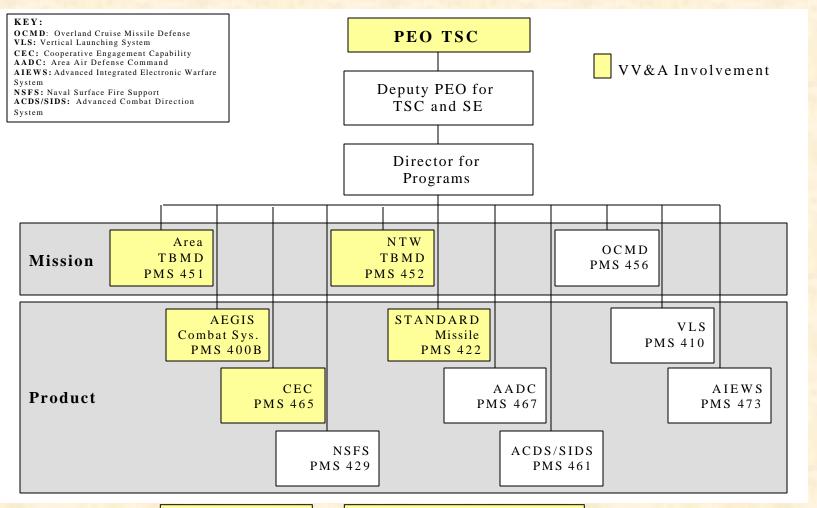


- → TD1MS Coordinates Actions in Response to External Requests for M&S Data
- → TD1MS Conducts Initial Review in Consultation With the Members of the MSSC
- □ TD or TA May Assign Response Lead to a PM, If Not TD1MS
- Certification and Release of M&S Data Representing System Capabilities Are Made by the System PM, in Coordination with Other PMs and TD1MS
- Action Progress Reports Shall Be Filed by the Response Lead In the VV&A Data Base/ Web Site



### **VV&A Implementation**





**LPD 17** 

**COMOPTEVFOR** 



#### **M&S VV&A Team Activities**



√ Help achieve M&S accreditation

✓ Help execute the process



✓ Follow DoD, DoN,
PEO JSC guidelines



✓ Help determine essential VV&A activities

✓ Help define M&S
Requirements and
Acceptability Criteria

✓ Develop and tailor VV&A process to Program Office needs



✓ Help identify key people and documentation needed







# VV&A Team Project Status 28 September 2000





# **CEC DOF CTI**



Document	<b>Due Date</b>	Completion Date	% Complete	Issues
TEMPER Accreditation Plan	8/31/00		99%	Plan written. Completed review process. Awaiting signature.
FirmTrack Accreditation Plan	8/31/00		99%	Plan written. Completed review process. Awaiting signature.
WCS EFCP Accreditation Plan	8/31/00		99%	Plan written. Completed review process. Awaiting signature.
TEMPER V&V Plan	9/11/00	9/5/00	100%	Plan written. Approved by SCP.
FirmTrack V&V Plan	9/11/00	9/1/00	100%	Plan written. Approved by SCP.
WCS EFCP V&V Plan	9/11/00			Plan written. Under review.
TEMPER V&V Report	9/22/00			Under development.
FirmTrack V&V Report	9/22/00			Under development.
WCS EFCP V&V Report	9/22/00			Under development.



# CEC



Document	Due Date	Completion Date	% Complete	Issues
CEP WASP Designation Letter	5/11/00		99%	In signature.
CEP WASP Accreditation Plan	8/15/00	8/15/00	100%	Plan approved.
CEP WASP V&V Plan	9/8/00	9/18/00	100%	Plan approved by SCP.
CEP WASP V&V Report	10/13/00		10%	In development.
DDS System Lab Designation Letter	5/11/00		99%	In signature 8/22.
DDS System Lab Accreditation Plan	8/20/00		99%	Plan approved. Sent for signature on 8/14.
DDS System Lab V&V Plan	9/18/00		75%	In development.
OTIIA3 Accreditation Package	9/14/00		99%	Signature – COTF.
OTIIA4 Designation Letter		5/1/00	100%	Complete.
OTIIA4 Accreditation Plan				Sent to PMS465 for signature 9/7. Received COTF comments 9/13. Incorporate comments before signature.
OTIIA4 V&V Plan				In development. Draft to SCP Chair 9/14-15.



# NTW TBMD M&S



Document	Due Date	Completion Date	% Complete	Issues
NTW M&S Accreditation Process Plan	8/24/00		99%	Final copy routed for signature.



## NAVY AREA TBMD M&S



Document	Due Date	Completion Date	% Complete	Issues
M&S Accreditation Process Plan for Navy Area TBMD Program	9/30/97		99%	Delivered to Program Office for signature 9/15/00.
JHU/APL Designation Letter (FirmTrack)		1/31/00	100%	Complete. Signed.
FirmTrack Accreditation Plan	8/31/00		75%	2 <sup>nd</sup> review complete. Awaiting Acceptability Criteria. Reviewing QIRs.
LM Designation Letter (ACSIS, MEDUSA, SSTRESS)		1/31/00	100%	Complete. Signed.
ACSIS Accreditation Plan	8/31/00		85%	2 <sup>nd</sup> review complete. Reviewing QIRs.
MEDUSA Accreditation Plan	8/31/00		85%	2 <sup>nd</sup> review complete. Reviewing QIRs.
SSTRESS Accreditation Plan	8/31/00		75%	2 <sup>nd</sup> review complete. Reviewing QIRs.
ACSIS, MEDUSA, SSTRESS V&V Plan	8/31/00		75%	Completed by MSP. In review with VV&A TBMD Team.



# **HWIL**



Document	Due Date	Completion Date	% Complete	Issues
HWIL NP-3D V&V Plan	10/6/00		75%	Initial plan sent to VVA Team Chairperson for review 9/26/00.
HWIL NP-3D V&V Report	10/20/00		75%	Initial report sent to VVA Team Chairperson for review 9/26/00.
HWIL SCSC V&V Plan	10/6/00		75%	Initial plan sent to VVA Team Chairperson for review 9/26/00.
HWIL SCSC V&V Report	10/20/00		75%	Initial report sent to VVA Team Chairperson for review 9/26/00.
HWIL EVT V&V Plan	10/6/00		75%	Initial plan sent to VVA Team Chairperson for review 9/26/00.
HWIL EVT V&V Report	10/20/00		75%	Initial report sent to VVA Team Chairperson for review 9/26/00.
HWIL MFLBTS V&V Plan	10/6/00		75%	Initial plan sent to VVA Team Chairperson for review 9/26/00.
HWIL MFLBTS V&V Report	10/20/00		75%	Initial report sent to VVA Team Chairperson for review 9/26/00.



#### **Summary**



→ PEO TSC Instruction 5200.3, "VV&A of M&S," 4 February 2000

→ PEO TSC Best Practices Guide for Verification, Validation and Accreditation – Draft

Under review





## **BACK UP SLIDES**



# Verification & Validation Techniques



#### Informal

Audit
Desk Checking
Face Validation
Inspections
Reviews
Turing Test
Walkthroughs

#### Static

**Cause-Effect Graphing Control Analysis Calling Structure Concurrent Process** Control Flow **State Transition Data Analysis Data Dependency Data Flow** Fault/Failure Analysis **Interface Analysis** Model Interface **User Interface Semantic Analysis** Structural Analysis **Symbolic Evaluation** Syntax Analysis **Traceability Assessment** 

#### **Dynamic**

**Acceptance Testing** 

**Alpha Testing Assertion Checking Beta Testing Bottom-Up Testing Comparison Testing Compliance Testing** Authorization Performance Security **Standards** Debugging **Execution Testing** Monitoring **Profiling** Tracing **Fault/Failure Insertion Testing** Field Testing Functional (Black-Box) Testing **Graphical Comparisons Interface Testing** Data Model User

#### **Formal**

Induction
Inference
Logical Deduction
Inductive Assertions
Lambda Calculus
Predicate Calculus
Predicate Transformation
Proof of Correctness

Object-Flow Testing Partition Testing



#### **V&V Techniques (Continued)**



Informal Static

#### **Dynamic**

**Formal** 

**Predictive Validation Product Testing Regression Testing Sensitivity Analysis Special Input Testing Boundary Value Equivalence Partitioning Extreme Input Invalid Input** Real-Time Input **Self-Driven Input** Stress **Trace-Driven Input** Statistical Techniques Structural (White-Box) Branch Condition **Data Flow** Loop Path Statement Submodel/Module Testing Symbolic Debugging **Top-Down Testing** Visualization/Animation



#### **Models & Simulations**



- "Model A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process"
- "Simulation A method for implementing a model over time"

DOD Directive 5000.59, "DOD M&S Management," 4 January 1994